

POST-PALEOZOIC ROCKS

Qal ALLUVIUM (QUATERNARY)—Sand, gravel, silt, and clay; brown to gray and gray green. In stream channels and flood plains. Grades into colluvium along margins of some streams. Locally may include swamp deposits

Qt TERRACE DEPOSITS (QUATERNARY)--Sand, gravel, and silt along stream terraces. Locally may include minor amounts of colluvium

Tsgc UPLAND DEPOSITS AND COASTAL PLAIN SEDIMENTS (TERTIARY-PALEOCENE TO PLIOCENE)--Mostly gravel, sand, silt, and clay of undivided Tertiary age

TKu COASTAL PLAIN SEDIMENTS (EARLY TERTIARY AND EARLY CRETACEOUS)--Includes gravel, sand, silt, and clay as well as glauconitic sand and sparse sandy limestone (Tertiary), and locally cross-bedded

JRu CULPEPER BASIN ROCKS (TRIASSIC AND JURASSIC)—Reddish conglomerate, sandstone, siltstone, and shale (Triassic) with gray to black basaltic intrusions (Jurassic); undivided

Mzd DIABASE DIKES (JURASSIC?)—Crystalline, medium— to fine-grained, dark-gray to black, generally intergranular to ophitic textured basaltic rocks. Predominantly bytownite-augite diabase with opaque minerals and locally minor biotite as common accessories. Less common diabase contains fayalitic olivine with more calcic bytownite than olivine-free diabase

PALEOZOIC AND PROTEROZOIC ROCKS METASEDIMENTARY AND METAVOLCANIC ROCKS

QUANTICO FORMATION (ORDOVICIAN)--In the northeastern part of its strike belt it is a gray-to-black slate that is commonly very carbonaceous and pyritic and locally contains layers of graywacke, which in places are graded. There, near the base of the Quantico, a horizon composed of beds of felsic tuff, thin felsic flows, quartzite, and silty slate and a second horizon composed of chlorite-actinolite greenschist are also present. These strata in the northern strike belt are of only ocal importance, as they have not been found in comparable positions in the Quantico to the southwest. The Quantico to the southwest appears to enclose various metasandstone beds at various horizons, and the metamorphic grade also increases to the southwest. Just north of the Rappahannock River, the Quantico abruptly changes from slate and phyllite to a dark-gray biotite-muscovite schist. Southwest from this point, the degree of metamorphism generally increases, producing fine- to medium-grained staurolitic schist and biotite-muscovite garnetiferous schist that locally contains fibrolitic sillimanite or kyanite. Muscovite is more abundant than biotite. Chlorite is mostly a retrograde mineral after biotite or, less commonly, marginal alteration on garnet. Staurolite locally is partially altered to a micaceous shimmer aggregate. In general, raphitic schist within the Quantico is sparse and irregularly distributed south of the Rappahannock River. Quartzite (Oqq) forms thin discontinuous lenses within and locally at the base of the Quantico. Most of these quartzitic lenses are quartz or feldspathic meta-arenite and metawacke. In places brolite is found. Locally, along the contact with the underlying Chopawamsic Formation, the basal quartzite of the Quantico is a mylonite. Thin, pale green, diopsidic calc-silicate layers several entimeters thick are found locally in the lower part of the Quantico

Formation

Oph POPES HEAD FORMATION (ORDOVICIAN)--Probably Station Hills Phyllite
Member of the Popes Head--Greenish-gray phyllite with sparser amounts
of metasiltstone

Ou UNDIVIDED METASEDIMENTARY ROCKS (ORDOVICIAN)--Gray to green silty
phyllite, gray to white metasiltstone and fine-grained quartzite,
fine-grained mica schist or semi-schist, green slate and phyllite and
sparse granule quartzite and graywacke layers. May be coeval, in
part, with Old Mill Branch Metasiltstone Member of the Popes Head

Op PHYLLITE (ORDOVICIAN)--Mostly gray-to-green phyllite with lesser
amounts of metasiltstone and locally with metasiltstone lenses
(Ops). May be coeval with Oph. Mylonitic rocks (Opm) composed
commonly of semi-schist or phyllite with elongate granules of quartz
that occur in the southern part of the northern outcrop belt of Op

(Ops). May be coeval with Oph. Mylonitic rocks (Opm) composed commonly of semi-schist or phyllite with elongate granules of quartz that occur in the southern part of the northern outcrop belt of Op are interpreted as highly tectonized parts of this formation.

Alternatively, these mylonitic rocks may be part of a separate and older terrane

Oct TRUE BLUE formation - informal name (ORDOVICIAN OR CAMBRIAN OR BOTH)
Consists primarily of calcareous and noncalcareous slate and siltstone and lesser amounts of argillite. Includes lenses of Everona Limestone (Octe) and quartzite (Octq). Minor amounts of chert and ironstone are also locally present

These melanges of Ordovician or Cambrian age or both, consist of a variety of metaplutonic, metavolcanic, and mafic and ultramafic exotic blocks enclosed within a matrix of phyllite or schist and metasandstones of feldspathic or quartz metagraywacke. These melanges are mapped as the Mine Run Complex, which is interpreted to consist of four imbricated thrust slices each with its own distinctive exotic block content

MINE RUN COMPLEX (ORDOVICIAN AND/OR CAMBRIAN)—The four thrust slices that comprise the Mine Run Complex are numbered from east to west as I through IV. In general, the matrix rocks of these four melange zones in fresh outcrop are various shades of gray or green and many of the matrix rocks are metagraywackes

Block-in-phyllite melanges 1

Melange zone I--The easternmost melange zone contains a few widely scattered exotic blocks. The matrix rocks of this melange zone are fine-grained schist and phyllite locally enclosing coarsegrained metasandstone beds. Felsic (6vf) and mafic (6vm) metavolcanic rocks and mylonitic granitoid masses (6gn) form the two types of exotic blocks in the melange zone. Metavolcanic rocks commonly are little deformed metafelsites that resemble metafelsite of the Chopawamsic Formation (6c) to the east of this melange zone. The blocks of metafelsite have a fine-grained quartzofeldspathic groundmass in which are embedded phenocrysts of euhedral albitic feldspar and minor anhedral quartz grains that locally show corrosion embayments. Intermediate to mafic metavolcanic and metavolcaniclastic blocks are present in lesser quantities and generally are well foliated, aphanitic to finegrained schists and phyllites. For the most part they consist of fine-grained, generally actinolitic amphibole, quartz and plagioclase. Such rocks are also common in the Chopawamsic Formation to the east. Blastomylonitic tonalite and granodiorite gneisses (67g) are present in two separate blocks. Metatonalite gneiss commonly is characterized by a finely comminuted quartzofeldspathic groundmass ocally recrystallized into granoblastic "patches." Enclosed within the groundmass are plagioclase crystals that are locally broken. Irregular, anastomosing foliation is defined by finegrained brown biotite and less abundant muscovite. These oliation zones suggest shear zones along which the rock was oriented at various angles to the rock foliation. Garnet is locally present. Texturally, the granodiorite gneiss is simila to the tonalite gneiss. Altered plagioclase and less abundant

microcline are megaclasts set in a fine-grained quartzose roundmass and around which wraps the anastomosing foliation ranular sphene is a common accessory, whereas epidote is uncommon O@mII Melange zone II--Immediately west of melange zone I lies a thrust slice with metavolcanic blocks similar to those in melange zone I and with granitoid blocks that contrast in size and composition. he matrix of melange zone II consists of schist or phyllite that is deformed more complexly than the matrix rocks of melange zone Many have crenulation cleavage. Most of the schist and phyllite of melange zone II are fine-grained, well-foliated rocks composed chiefly of quartz, muscovite, and chlorite and are at reenschist-facies grade of metamorphism. Fine-grained, rounded detrital(?) epidote is sparse, and metamorphically formed garnet is present locally in small amounts. Metasandstones are also relatively abundant in the matrix of melange zone II. Most of the etasandstones are quartz metagraywacke and quartz-feldspar metagraywacke. Quartz metagraywacke consists of poorly sorted, rounded to subangular quartz grains suspended in a groundmass o fine-grained muscovite with or without chlorite. Accessory minerals include sphene and rare epidote. Quartz metagraywackes lso contain detrital feldspar. Some quartz metagraywackes are weakly foliated, whereas others are strongly foliated. Micaceous quartzose metasiltstone is also a relatively common matrix Mafic (6vm) and felsic (6vf) metavolcanic rocks similar to those ound as blocks in melange zone I and in the Chopawamsic Formation to the east also occur at a few places as small blocks within melange zone II. The more diagnostic blocks of this zone, however, are altered tonalite and granodiorite (etg). These granitoids are interpreted as being exotic blocks rather than intrusions for several reasons. For the most part, they are

transected by mylonitic seams. They lack associated gravit anomalies that would suggest any significant size and have no iscernible contact metamorphic aureole O6mIII Melange zone III--Phyllite and schist are the matrix lithologies of this melange zone. One of its major features is the abundance of euhedral magnetite. This magnetite invariably truncates or rosscuts rock foliation and is believed to be a late metamorphic mineral. Many of the matrix rocks are highly deformed on a mesoscopic and microscopic scale. In outcrop, some rocks have a pin-striped aspect that in thin section can be demonstrated as caused by spaced cleavage. Quartzose phyllite with muscovite. biotite, and minor garnet is a common matrix lithology. Local detrital feldspar is also present. In such phyllite and schist euhedral magnetite is more abundant in the micaceous folia than i the general groundmass. Polydeformation of the matrix phyllites and schists is evident from the folding of early foliation. Coarse-grained metasandstone and metaconglomerate beds are sparse local matrix lithologies in melange zone III. Most such rocks are resent near the latitude of the Rappahannock River. Muscovition quartz phyllite is more abundant north of the Rappahannock River. Contact metamorphism has affected the matrix rocks along the margins of the late kinematic Ellisville Pluton where a therma aureole has developed. Close to the Ellisville Pluton, country ock, normally fine-grained garnet-biotite-muscovite-quartz schist, is altered to muscovite-biotite-fibrolite schist. Fibrolite occurs in coarse-grained muscovite and, less commonly in recrystallized quartz. Some kyanite-bearing quartzite near the llisville Pluton is also a result of contact metamorphism. Mafic (62m) and undivided ultramafic blocks (62u) and a few blocks of felsic (Evf) and mafic (Evm) metavolcanic rocks, biotite gneiss (62bg) and mylonitic metatonalite are present locally within 6Za) are a common type of exotic blocks. These rocks are actinolite-bearing and have greenschist facies mineral assemblages including epidote and albite. They can be massive or foliated. Foliation, where present, commonly is caused by alignement of

sheared or have cataclastic textures. Locally, they are

EmIII as are sparse blocks of gneiss (EZg). Amphibolitic rocks amphibole. Some exotic blocks have an internal foliation that iffers in trend from the regional foliation in the enclosing metasedimentary rocks, indicating that their foliation form before being incorporated as blocks in melange zone III. Layering is rare in exotic blocks and, where seen, is folded. Leucocrati small, irregularly shaped masses of plagiogranite intrude some of green actinolite that may occur as clear grains or be partly altered to chlorite. Twinned or untwinned plagioclase is generally less abundant than amphibole and, in most places, is highly altered. In some rocks it is replaced, in part or in whole, by some member of the epidote group, commonly zoisite with anomalous blue interference colors. Quartz is present in small amounts in most greenschists. White mica occurs in small amounts very locally, and brown biotite is even sparser. In places, finegrained, granular to subhedral sphene is present. Where contactmetamorphosed by the Ellisville Pluton, the amphibolitic rock is more coarsely crystalline and less altered. Such rocks are characterized by clear, twinned andesine (composition by plagioclase twin-extinction method) and clear hornblende xturally, such amphibolite consists of mutually interfering grains of plagioclase and amphibole. Metamorphosed ultramaf rocks also form abundant exotic blocks within melange zone III. These include foliated to massive antigoritic serpentinite (&Zse). The most common texture of the fibrous serpentine, which is the characterizing mineral of these rocks, is interpenetrating, out locally, some mesh textures are present in pseudomorphously replaced rocks. In some places, pseudomorphously replaced earlier minerals are characterized by antigorite surrounded by chlorite. Chromian magnetite is an accessory mineral in most serpentinites. In thin section, magnesite generally occurs in single well-formed crystals or in small aggregates, commonly with ircular to elliptical shapes. It is scattered randomly through the serpentinite but it aggregates in places, and grains surround what appear to be minerals pseudomorphously replaced by interpenetrating-textured serpentinite. Thin gash veinlets filled vith fine-grained fibrous talc are found in a few serpentinites Some serpentinites are highly tremolitic, and some are foliated. In tremolitic serpentinites, small pseudomorphs(?) of interpenetrating serpentine also are present. Massive as well as

are composite and are composed of various amounts and combinations of serpentinite (6%u), amphibolite (6%a), talc (6%t), or mafic O6mIV Melange zone IV--This melange zone is bounded on its western side by the Mountain Run Fault Zone and on the east by the inferred thrust fault that separates it from melange zone III. Melange zone IV also contains euhedral magnetite. Southwestward, beyond the map area, melange zone IV apparently merges into or is a continuation of some of the phyllitic rocks assigned to the Candler Formation of the Evington Group. Melange zone IV contains few exotic blocks in the map area. However, some large mafic-ultramafic masses enclosed within what has been mapped as Candler Formation by others have been interpreted as exotic blocks within this melange Within melange zone IV immediately west of melange zone III, fine-grained, gray-green to green metavolcanic phyllites are ntercalated with metavolcaniclastic phyllites and other metasedimentary rocks (0 $\Theta$ mIV). In thin section, the metavolcanic phyllites typically consist of silt-sized quartz as the predominant clast in laminae and folia with accessory chlorite aligned in the foliation direction. Equally as common are foli and/or lamina of chlorite or chlorite and granular epidote in which quartz is a minor constituent. Plagioclase commonly forms larger clasts within the fine-grained phyllite matrix of some o these rocks, and the silt-sized quartz grains are recrystallized or flattened in the direction of the rock foliation. Some layers may be metafelsites or, in part, metatuff. Several fine-grained

metavolcanic rocks have nematoblastic actinolite, subhedral

epidote, minor brown biotite, and silt-sized quartz. Locall

euhedral magnetite is abundant. The interlayered metasedimenta

agnetite, where present, mostly is localized in the micaceous olia. The zone of metavolcanic and intercalated metasedimentar

rocks of melange zone IV, however, predominantly are chloritic metasiltstone with folia of muscovite and chlorite. Euhedral

foliated talc (62t) forms sparse exotic blocks within melange

monomineralic exotic block within melange zone III. Many blocks

possibly black-wall) formed with serpentinite is a rare

talc and sparse amounts of chlorite and magnetite. Chlorite rock

Talc rock commonly is made up of fine- to very fine-grained

rocks passes gradationally across strike to the west into mostly fine-grained metasandstone and metasiltstone (O6mIVq). Chloritemuscovite-rich thin beds and laminae are intercalated with such metasandstones. Plagioclase, where present, occurs as coarser grains than the quartz-rich matrix in which it is embedded. In a few of the micaceous laminae of quartzites, very ine-grained subhedral sphene is present and may have been derived from air-fall volcanic dust that settled into a muddy sediment. Thin diamictic lenses that contain phyllite and other fragments occur in melange zone IV just east of the Greensprings Pluton in the southwest part of the map area. Deformation in melange zone IV is demonstrated by microfolds; shearing is common in such folds. Westward across strike, near the Rapidan River, the fine-grained quartzites gradually develop anastamosing foliation planes, and layering and folds are disrupted by shearing. Eventually, quartzites grade into and become indistinguishable from the phyllonites and mylonites of the fountain Run Fault Zone. This fault zone apparently truncates the northeast-trending melange zone IV. To the south, the quartzitic rocks are succeeded westward across strike by gray-green quartzmuscovite-chlorite phyllites that have local layers and lenses of impure quarzite, a lithology that is common in the Candler

Formation to the southwest.

Metadiamictite-type melanges A widespread type of melange with a quartzofeldspathic matrix distinct from the phyllite or schist matrix found in the Mine Run Complex is the metadiamictite type. Melange of this type is characterized by a commonly nonstratified, micaceous, quartzofeldspathic matrix (metagraywacke) in which are embedded clasts of metasedimentary and meta-igneous rocks ranging in size from granule to boulder and larger sizes. Some of the schist and gneissic clasts in the metadiamictite possess an internal foliation that is athwart that of the northeast-trending regional foliation of the matrix. One of the characterizing features of metadiamictite melange is the ibiquitous quartz granules, pebbles, and less commonly, boulders. Many of these quartz clasts, referred to locally as quartz lumps, are aggregates of granoblastic quartz. The quartzofeldspathic groundmass, the quartz lumps and the schist fragments are considered to be the sedimentary milieu of the amictite-type melanges, which were derived from a common source area during discrete sedimentation episodes. This conglomeratic sediment, essentially a feldspathic graywacke, is the matrix for the other exotically derived blocks. The diamictite melange deposits composed of blocks in a uartzofeldspathic matrix lie northeast of the block-in-phyllite type of the ine Run Complex. They occur as three lithologically distinct deposits, mapped as the Sykesville (06s), Lunga Reservoir (061), and Purcell Branch OG1 LUNGA RESERVOIR FORMATION (ORDOVICIAN OR CAMBRIAN OR BOTH) -- Near Lunga Reservoir, the metadiamictite is a dark-gray rock with a deceptive

resemblance to a granitoid. Typically, the groundmass is micaceous

and quartzofeldspathic. Rounded to subrounded quartz grains range in size from silt to sand and are the most abundant constituents of the groundmass. Rounded to subrounded plagioclase is also common, whereas potassic feldspar is sparse to absent. Fine-grained muscovite is abundant in the groundmass and also occurs as coarse poikilitic porphyroblasts. Green biotite, commonly inclusion-free forms smaller porphyroblasts. Garnet is locally a common minor constituent and euhedral to subhedral magnetite is ubiquitous. Chlorite, also an ever-present constituent, has replaced biotite in places. Epidote is generally a local minor accessory. As stated above, one of the most characteristic types of clasts of the metadiamictites are the granules, pebbles, and cobbles of colorless to milky quartz lumps that show a granoblastic texture in nin section; such clasts probably represent recrystallized fragments of vein quartz. Other common clasts in this part of the Lunga Reservoir Formation are mica schists that locally contain garne Commonly, schist fragments are dimensionally aligned along the rock foliation, but in a few places their internal foliation is athwar that of the enclosing groundmass. Other rare clasts include calcsilicates. Thus, the "matrix" of metadiamictite, as used herein, consists of the micaceous quartzofeldspathic groundmass as well as quartz lumps and schist or gneiss clasts. Exotic fragments includ mafic (6Zm) and ultramafic rocks, but these are very sparse in this part of the formation. A few amphibolitic, pebble- to cobble-sized exotics are present as is a boulder of greenstone. compositional change in the Lunga Reservoir Formation from south to north is relatively gradual. The groundmass rocks at the northern end are not well know because they are poorly exposed and have been altered extensively to saprolite or clay residuum. In the northern part of the formation, the matrix is essentially of micaceous quartzofeldspathic composition. However, rather than being entirely massive, some of the matrix locally is faintly layered. Quartz clasts are also present here, but they are few and are scattered very widely. Rock chips are sparse or absent. Cobble- to boulder-sized, generally rounded, ultramafic (62u) and mafic rocks

PURCELL BRANCH FORMATION (ORDOVICIAN OR CAMBRIAN OR BOTH) -- This formation, also a diamictite, is in the greenschist facies of metamorphism but has been retrograded. The matrix rocks of the Purcell Branch resemble Lunga Reservoir matrix rock in composition dark gray color, and absence of bedding. The Purcell Branch, however, has a pervasive anastomosing foliation. In many places biotite has been altered to chlorit Quartz lumps within the Purcell Branch are, for the most part, sparse, of smaller size, and have undergone more tectonic flattening and recrystallization than those in diamictite of the Lunga Reservoir. Metasedimentary rock chips in the Purcell Branch matrix ocks are sparse, and those noted are low-grade, fine-grained phyllite, which is in contrast to the schist chips found in the Lunga Reservoir Formation. A variety of blocks, several meters to probabl several hundred meters in length, occur within the Purcell Branch Formation and are believed to have been derived from the Chopawamsic mation. Felsite blocks (6vf) are primarily quartz metakeratophyres. Greenstones and greenschists (6vm) also are exotic blocks constituents within the Purcell Branch. In addition, blocks of less certain origin are also present and include mafic rocks ( $\ensuremath{\text{GZ}m}$ ) and amphibolite (62a). Poor exposures of granitoids of the Goldvein luton (06g) and Lake Jackson Pluton (06lj) remain enigmatic, being either dikes or possibly anotic blocks.

SYKESVILLE FORMATION (ORDOVICIAN OR CAMBRIAN OR BOTH)--A diamictite

with a matrix generally similar to that of the Lunga Reservoir and

with quartz lumps as a distinguishing feature. Its exotic block

(6vm) are locally abundant. Locally along the contact with the

Chopawamsic (6c) the Lunga Reservoir Formations contains fragments

composition is more diverse but in the map area most of these are  $% \left( 1\right) =\left( 1\right) \left( 1\right) \left$ CHOPAWAMSIC FORMATION (CAMBRIAN) -- The Chopawamsic Formation consists of lenses and tongues of metavolcanic and metasedimentary rocks and does not contain single units that have great lateral extent. The metavolcanic rocks include silicic, intermediate, and mafic varieties, some of which probably were flows, as suggested by their highly vesicular character. Fragmental rocks are mainly breccias and tuffs. Many fine-grained feldspathic schists and phyllites without identifiable fragments are similar mineralogically and chemically to the more distinctive volcanic rocks and may be tuffaceous. Schists, meta-arenites, and locally, amphibole-free gneisses of probable sedimentary origin are interlayered with the clearly metavolcanic rocks, and the proportion of such metasedimentary rocks varies from place to place along the formation. Silicic metavolcanic rocks typically are light gray and some have small phenocrysts of quartz and/or feldspar. Some felsic metavolcanic rocks contain albitic plagioclase and quartz in a finer grained quartzofeldspathic groundmass and are keratophyres. In some rocks, plagioclase phenocrysts originally more calcic than albite are now slightly altered to epidote. The intermediate metavolcanic rocks are dark t ight green, and commonly have a nematoblastic groundmass texture formed by aligned prismatic amphibole intergrown with fine-grained quartz and feldspar. Some of the porphyritic felsites contain quartz-eye and/or feldspar phenocrysts; some of the quartz phenocrysts are as much as 1 cm in diameter and have resorbed margins. The mafic rocks of the Chopawamsic Formation include amphibolite greenstone, and various dark schists. Principal minerals of such greenstones are blue-green amphibole, albitic plagioclase, and quartz, and chlorite. Epidote, magnetite, and chlorite are minor accessories. The dark schists are rich in biotite and chlorite and

may have originated as fine-grained volcanic layers of basaltic to intermediate composition. Fine-grained porphyroblasts of blue-gree actinolitic amphibole are arranged locally as fascicules in the mafic TA RIVER METAMORPHIC SUITE (CAMBRIAN) -- In the northern part of its outcrop belt the Ta is chiefly amphibolite gneiss associated with conformable granitoid rocks and smaller amounts of biotite gneiss and schist. To the southwest along strike, the Ta contains more biotite gneiss and schist and smaller amounts of amphibolite gneiss. An increase in regional metamorphic grade also occurs in the southwest part of the Ta River, and the associated granitoid bodies include more felsic types than does the northeast part of the Ta River Metamorphic Suite. The characterizing amphibolitic rocks of the Ta are generally dark-gray to black, well-foliated gneiss units that are rarely layered. The gneiss ranges from amphibolite through various ypes of amphibolite gneiss to biotite gneiss. Some of the phibolite in the southern part of the outcrop belt contains roxene, which may reflect higher grade regional metamorphism here an in the Ta River terrane to the northwest. Amphibole in these rocks is a green hornblende (commonly poikiloblastic), and the plagioclase, both twinned and untwinned, ranges from andesine to bytownite. In general, textures in thin section range from granoblastic to foliated by dimensionally aligned grains. Epidote is present generally in subhedral grains, and in some gneiss it is PETERS CREEK SCHIST (CAMBRIAN?) -- Present only in a thin thrust slice at

lacks the numerous exotic blocks of mafic and ultramafic rocks i contains farther to the north. It is considered to be another type block-in-phyllite melange deposit QUARTZITE-SILTSTONE-GRANULE CONGLOMERATE (CAMBRIAN)--Siliciclastic metasedimentary rocks that form discontinuous lenses unconformably above the Catoctin Formation (Zc). Some of the metasiltstones and fine-grained quartzites show cross-bedding and channel structures. er quartzite have well-rounded quartz grains HOLLY CORNER GNEISS (CAMBRIAN OR PROTEROZOIC) -- The characterizing lithology of the Holly Corner is dark-gray to black, fine- to mediumgrained, well-foliated hornblende- and biotite-rich gneiss. Compositional layering is rare and where present generally consists of thin calcsilicate layers. Typically the Holly Corner is an amphibole gneiss containing varying amounts of biotite. Locally piotite is the dominant dark mineral. Generally the amphibole is a green hornblende, and the plagioclase is andesine, reflecting amphibolite-grade metamorphism. Biotite is reddish brown, and epidote is common as, in lesser amounts, is sphene. Locally, the Holly Corner contains potassic feldspar near large granitoid intrusions. Pyroxene, marginally altered to hornblende, is prese locally in the Holly Corner within the synform that overlies the Falls Run Granite Gneiss (Sfr) north of the Rappahannock River Sparse, thin (generally less than 10 cm thick), gray- to pale-gree lcsilicate layers are present in parts of the Holly Corner neiss. In thin section the calculicate layers of granoblast quartz and plagioclase (andesine) contain epidote and diopsidi pyroxene. Abundances of green hornblende and biotite are variable in different layers. Calcite is present locally in small amounts. along the contact between the Holly Corner Gneiss and the Quantic Formation and are provisionally included with the Holly Corner Gneiss. They are shown as lenses at the top of the Holly Corner

the northern edge of the map area. Here the unit consists of

magnetite-bearing sandy to pelitic green phyllite and schist but

Gneiss based on the interpretation that the Holly Corner is the inverted limb of a nappe and is contained in a downward facing TOMAHAWK CREEK formation - informal name (CAMBRIAN OR PROTEROZOIC)--Green and gray phyllite and graywacke
PzZp PO RIVER METAMORPHIC SUITE (PALEOZOIC(?) AND/OR PROTEROZOIC)--Biotite gneiss and schist; the most common lithology is biotite gneiss. naracteristically the gneiss is a dark-colored, layered, and foliated rock; micaceous minerals are concentrated in the dark layers and quartz and feldspar in the light layers. However, all gradations the relative proportions of mica, quartz, and feldspar are found n the various layers that constitute the gneiss. Feldspar occurs both as a groundmass constituent and very commonly in large augen. Plagioclase (twinned and untwinned) is almost invariably the most bundant mineral and is followed in decreasing order of abundance by the characterizing biotite and then by quartz. Microcline is generally a minor constituent, and epidote and myrmekite also are common minor constituents. Hornblende-bearing gneiss is present but is less abundant than the biotite gneiss. It resembles the biotite neiss in color and texture but contains varying amounts of fornblende as well as biotite. Garnetiferous two-mica schist is found locally in the Po River Metamorphic Suite and has a foliation conformable with the adjacent gneisses Numerous foliated gneissic granitoid rocks, including pegmatoids, are found as tabular bodies, as well as nontabular masses, in the Po River. The tabular granitoid and pegmatoid bodies form concordant. sill-like layers. They range from less than 2.5 cm to as much as about 7.6 m wide. Locally, thinner granitoid layers about 0.5-1.0 cm wide are conformable with the foliation in the gneiss. The nontabular irregularly shaped granitoid bodies generally form relatively large masses that may be parts of plugs and plutons of various sizes. Biotite is invariably the more abundant of the micas and is aligned along foliation. The quartz and feldspar have weak to marked orientation within foliation in most rocks. In thin section bulbous and rim myrmekite are ubiquitous minor constituents. Clear, more sodic rims of plagioclase grains also are found locally at In the southern outcrop belt of the Po River Metamorphic Suite several lenticular units can be distinguished. PzZpm, is a fine- to coarse-grained, strongly foliated, strongly layered (0.5 cm-0.3 m) garnet-muscovitic quartzofeldspathic gneiss; locally it grades into biotite gneiss. Mica grain terminations are locally ragged. Most microcline and plagioclase grains are sericitized and turbid. Garnets are anhedral, generally free of inclusions, incipiently fractured, altered to chlorite and iron oxide, and are slightly elongate parallel to a foliation defined by wispy micaceous layers and lenticular quartzofeldspathic masses. Epidote, sphene, and pyrite are minor constituents: capillary rutile was observed in one microcline grain. PzZpam is a fine- to coarse-grained, weakly to strongly foliated, irregularly layered amphibolite and amphibole gneiss. It occurs at different horizons in the Po River Metamorphic Suite. Some layers appear gradational into Po River biotite gneiss. Predominant minerals are subhedral to euhedral gree hornblende, and, locally, brown biotite, scapolite, garnet, and quartz. Some amphibolite is quartz-bearing and garnetiferous nhedral, poikiloblastic garnets are as much as 3 cm in diameter. iotite-hornblende gneiss locally contains rounded granules and pebbles of polycrystalline quartz. The quartz grains are unsorted in

a fine-grained biotite-hornblende-quartz-feldspar groundmass. The

groundmass foliation. Poikiloblastic, locally zoned and twinned

oliation. Grain boundaries in amphibolite with simple mineralogy

(epidote-hornblende-plagioclase) are generally straight. Irregula

plagioclase grains in places roughly parallel the groundmass

quartz grains are polygonized and are weakly elongate parallel to the

lagioclase grains are also present. Biotite inclusions within the

boundaries occur where scapolite, garnet, and calcite are present; some epidote grains have vermicular inclusions of clinozoisite(?). PzZpmb is a quartz-rich magnetite-bearing biotite gneiss which generally also contains muscovite and garnet and has a wide range in grain size

PzZph BIOTITE-HORNBLENDE GNEISS (LOWER PALEOZOIC AND/OR PROTEROZOIC?)—
Coarse-grained, moderately to strongly foliated, weakly layered epidote-microcline-biotite-hornblende-quartz-plagioclase gneiss with discontinuous layers of biotite gneiss and granitic biotite gneiss. Numerous lenticular or tabular, concordant to discordant, inclusions of fine-grained, foliated amphibolite range in length from a few centimeters to about 2 m. Microstructures are dominated by anhedral plagioclase and hornblende and generally irregular grain boundaries. Epidote is locally vermicularly intergrown with plagioclase(?)

Ec CATOCTIN FORMATION (PROTEROZOIC)—Greenstone, green phyllitic tuff and greenschist fragmental rocks (brecciated pillows?)

FALMOUTH INTRUSIVE SUITE (CARBONIFEROUS)—Consists of fine-grained monzogranite and pegmatitic granite, fine-grained granodiorite, and tonalite (less common). Both fine- and coarse-grained rocks occur as small plutons, tabular bodies concordant to the host-rock foliation or cross-cutting dikes. Some of the dikes are folded and in turn are cut by nonfolded dikes. Foliation, generally defined by dimensionally alined mica, is slightly to well formed and is commonly at an angle to wall-rock contacts of dikes. Locally the foliation is thly folded. These relationships indicate that the Falmouth rocks were emplaced during deformation (folded granitoids), as well as near the end of or after deformation (nonfolded and(or) poorly foliated In general, pegmatoid bodies are the youngest intrusions of the Falmouth in this terrane, as they invariably crosscut the granitoid dikes of the suite. The Falmouth granitoid rocks range chiefly from monzogranite (adamellite) to granodiorite and less commonly to tonalite, and rarely, to quartz-rich granitoid rock. Monzogranites typically are gray, fine- to medium-grained allotriomorphic granular Quartz constitutes about one third of the rock. Biotite and muscovite are common dimensionally aligned accessory minerals and amphibolite is minor. In some rocks bulbous myrmekite is enclosed by Granodiorites are generally gray to dark gray, fine- to mediumgrained allotriomorphic granular rocks in which plagioclase is volumetrically more abundant than microcline; quartz comprises about one third of the rock. Biotite and muscovite are common accessories with muscovite being most abundant in some granodiorites and biotite predominating in others. Myrmekite is common and locally abundant (five percent). Tonalite is a gray, fine- to medium-grained rock

than 10 percent and quartz about one third of the major minerals of the rock. Biotite is the characterizing accessory and myrmekite and epidote are minor. Amphibole is locally abundant (six percent). Pegmatoids, the youngest rocks of this Falmouth Intrusive Suite, range from muscovite-quartz-feldspar rocks to those in which muscovite is absent. Some appear to lack potassic feldspar and are tonalitic in composition. Some of the finer grained pegmatoid rocks have graphic texture

FALLS RUN GRANITE GNEISS (SILURIAN)—A pale-pink to nearly white, coarse-grained, strongly foliated hornblende and biotite granite gneiss ranging in composition from monzonite to granite. Microcline forms elongate generally poikiloblastic grains as much as several centimeters long that are oriented within the plane of foliation defined by biotite. The habit of microcline, biotite, and hornblende demonstrate the recrystallized nature of the Falls Run. Myrmekite is

with plagioclase generally being close to 50 percent, microcline less

demonstrate the recrystallized nature of the Falls Run. Myrmekite is found in plagioclase that is in contact with potassium feldspar. Accessory minerals include apatite, epidote, sphene, and opaque minerals

MUSCOVITE-BIOTITE GRANITE (SILURIAN? OR ORDOVICIAN?)—Dark gray granite with mosaic textured quartz with abundant microcline and minor sodic plagioclase. Poikilitic muscovite is more abundant than biotite. Epidote and titanite (sphene) are minor accessories

METATONALITE (SILURIAN? OR ORDOVICIAN?)—Fine grained leucocratic, hypidiomorphic granular, massive metatonalite—metaplagiogranite composed predominantly of sodic plagioclase and quartz and minor potassic feldspar. Quartz occurs as single grains or in mosaic—to granoblastic—textured aggregates. Thin cataclastic seams of quartz

with white mica locally cut the rock. Albitic plagioclase is both twinned and untwinned and is moderately to heavily altered by saussuritic granular epidote as well as fine-grained white mica. Epidote also occurs as a coarser, minor groundmass constituent POORE CREEK PLUTON (SILURIAN? OR ORDOVICIAN?) -- Leucocratic to mesocratic, massive, anhedral, medium-grained granitoids. Composed predominantly of amphibole-biotite quartz monzodiorite which has plagioclase that is both twinned and untwinned as well as locally zoned. It is invariably heavily clouded by fine-grained white mica alteration and submicroscopic irresolvable particulate matter. Such particulate matter commonly occurs in alteration bands at composition boundaries in zoned plagioclase. Granular, fine-grained epidote also clouds plagioclase. Quartz is a weakly strained, locally fractured and annealed interstitial constituent. Unaltered microcline, locally perthitic, is a minor interstitial mineral. Fine-grained, euhedral to subhedral, green pleochroic actinolite is the characterizing accessory and locally occurs as rare poikilitic crystals that encloses smaller grains of quartz, plagioclase and microcline. Brown, subhedral to euhedral, fine-grained biotite is also accessor but less abundant than amphibole. Pleochroic yellow, fine-grained,

anhedral epidote is a minor groundmass constituent as well as a granular, fine-grained alteration product within some plagioclase Less abundant dioritic rocks (amphibole granodiorite, amphibolie quartz diorite and amphibole monzodiorite) also occur in the pluton and are characterized by heavily altered plagioclase and finegrained, euhedral amphibole as the characterizing accessory ELLISVILLE PLUTON (ORDOVICIAN) -- The Ellisville Pluton is compose almost entirely of granodiorite that typically is coarse- to mediumgrained, commonly mesocratic, equigranular to porphyritic in texture and may be massive to strongly foliated biotitic rocks. Foliated, porphyritic rocks locally have well-developed trachytoid textures. The dominant felsic minerals of these rocks are quartz, plagioclase and potassic feldspar; biotite is invariably the characterizing accessory mineral. Potassic feldspar commonly forms megacrysts in porphyritic varieties and such megacrysts have a wide range in size, with 1.5 cm being their general length and 1.0 cm their general

Myrmekite is an ubiquitous fine-grained minor constituent of Ellisville granodiorite, invariably associated with potassic feldspar. It may be entirely enclosed by potassic feldspar or be marginal to the potassic feldspar crystals and in such cases it ommonly forms bulbous protrusions into the potassic feldspar. Some myrmekite contains relict polysynthetic twinning of plagioclase. Plagioclase crystals only partially enclosed by potassic feldspar are myrmekitic at the end enclosed by the potassic feldspar; the part of the plagioclase not enclosed by potassic feldspar remains as unmodified plagioclase. Myrmekite also occurs as a groundmass constituent but in all cases was formed in contact with groundmass potassic feldspar. In foliated granodiorite, quartz normally has a granoblasticpolygonal metamorphic texture and may form large aggregate masses t in hand specimen may have the outline of single grains. In massive samples, quartz occurs as large individual groundmass grains and in some rocks such quartz has undultory extinction. Fine-grained quartz also occurs in symplectic intergrowths with epidote and rarely, with biotite. Quartz, of course, is the fine-grained ermicular constituent of myrmekite Brownish green, strongly pleochroic medium-grained biotite is the characterizing, ubiquitous accessory in Ellisville granodiorite. I foliated rocks, biotite is dimensionally oriented and occurs generally in discontinuous wavy folia. However, within such folia individual biotite laths may diverge by appreciable amounts from the general trend of the rock foliation. In some rocks that have been deformed, the biotite is broadly bent and in places is strongly cinked. Commonly, biotite is closely associated with epidote sphene, allanite, and apatite, all of which it locally may enclose cically. In massive rocks it occurs in randomly oriented clots or as single randomly oriented crystals. Two generations of epidote are present in Ellisville granodiorite. The most common is the fine- to medium-grained wellcrystallized variety that is closely associated with biotite or occurs as a groundmass constituent. In places, epidote has nucleated on allanite, which locally, it completely encloses. In such cases the enclosing epidote has radiation-damage radial cracks developed around the allanite. Although closely associated with epidote allanite also occurs as discrete well-formed grains in the roundmass. The origin of the well-formed epidote is interpreted to be magmatic. The occurrence of well-formed epidote in subhedral grains with straight crystal faces in sharp contact with biotite o other juxtaposed minerals are considered evidence for magmatic origin. Local symplectic intergrowths of epidote and quartz also upports such an interpretation. Epidote also encloses euhedral magmatic titanite (sphene) further supporting the conclusion that epidote is a late magmatic mineral. Epidote in small amounts also occurs less abundantly as a fine-grained, granular, saussuriti alteration within plagioclase. Clinozoisite may also occur with, or independently from, such granular aggregates with altered plagioclase. Well-formed crystalline titanite (sphene) is an biquitous but minor constituent of these rocks. In many places unaltered titanite occurs as a well-crystallized overgrowth around an earlier rounded, generally oval-shaped alteration-clouded see crystal of sphene. Apatite occurs as small prismatic crystals. is commonly enclosed in biotite. In a few granitoids, wellcrystallized, pleochroic green amphibole occurs as a minor groundmas constituent. Plagioclase feldspars are locally crowded or sparsely ltered by fine grains of white mica. Well-formed muscovite, however, occurs in some of the granitoids as a primary groundmass constituent. Xenoliths within the Ellisville include granitoids (0g) and amphibolite (62a). LAHORE COMPLEX--Dark gray to black, fine- to medium-grained, massive to

faintly foliated pyroxene-bearing monzonite (Olp) occurs along the east side of the granitoid mass of the Lahore Complex. It grades westward into mesocratic, fine- to medium-grained, generally strongly foliated, amphibole-rich monzonite (Ola) that comprises the bulk of the granitoid mass. Foliation in the amphibole-bearing monzonites is commonly defined by the pronounced alignement of long, tabular crystals of feldspar and less so by the alignement of the ubiquitous amphibole. The presence or amphibole or pyroxene as the dominant mafic mineral is used in subdividing these rocks as pyroxene or amphibole monzonites. A poorly exposed mafic-ultramafic mass at the north end of the granitoids is included as part of the complex Olp PYROXENE MONZONITE (ORDOVICIAN)—Contains large, unaltered, microscopically colorless, locally twinned, nonpoikilitic and poikilitic augite as an abundant constituent. Poikilitic augite encloses apatite, opaque oxides and small crystal of biotite and

plagioclase. Plagioclase also is an abundant coarse-grained

crystals, the cores of some plagioclase are altered to fine-

onstituent that occurs as zoned and unzoned crystals. In zoned

grained patches of epidote; the rim in some plagioclase is clear

and albitic. Zoned plagioclase has core compositions ranging etween labradorite-bytownite and edge compositions in the rang of sodic andesine. The average composition of zoned plagioclase is andesine as is unzoned or poorly zoned plagioclase. Fine-grained microcline is an important groundmass mineral and has formed later than plagioclase which it locally replaces in some pyroxene monzonite. Greenish-brown biotite is an abundant medium-grained, groundmass accessory and occurs also as small inclusions in poikilitic pyroxene. Well-formed small crystals of apatite are accessory and occur in the groundmass and as inclusions in pyroxene. Single grains of amphibole are rare in pyroxene monzonite. Locally, however, pyroxene with irregular contacts occurs enclosed in the cores of amphibole grains. Most such amphibole is present in the gradational zone between pyroxen and amphibole monzonites. Sparse, fine-grains of quartz occur as a groundmass constituent in several rocks. Epidote is a fine-, subhedral to anhedral minor constituent AMPHIBOLE MONZONITE (ORDOVICIAN) -- The bulk of the Lahore granitoid mass consists of rocks that grade from amphibole monzonite to amphibole quartz monzonite in composition. The amphibole monzonites of the Lahore Complex are typically mesocratic, mediumgrained and well-foliated rocks and have a perceptible magnetic susceptibility (outcrop and hand specimens attract hand-held magnets such as stud finders). The marked foliation of these rocks is mostly imparted by the alignement of long tabular crystals of feldspar rather than of the associated biotite or hornblende. However, in detail, the feldspar alignement is not rigorous; indeed many crystals lie at some small angle to the overall foliation of the rock. The most abundant feldspar is potassic, most commonly microcline, and less commonly rthoclase. Andesine and quartz occur in varying but lesser amounts. The dominant dark mineral is amphibole, with biotite being generally present in lesser amounts. Andesine occurs as a groundmass constituent and as such it is commonly altered to a ass of small epidote-zoisite grains. The amount of such saussuritic alteration varies in different rocks and locally may completely pseudomorphically replace a plagioclase crystal. Fine grained white mica also occurs in places, as an alteration that clouds plagioclase. Plagioclase is present as both untwinned and twinned crystals and in some amphibole monzonites, is zoned. Commonly, plagioclase has clear, apparently sodic rims, generally where in contact with potassic feldspar. Small grains of plagioclase are common chadacrysts within poikilitic microcline Microcline, characterized by gridiron twinning, is commonly the characterizing feldspar. In some rocks, orthoclase is also present. Microcline occurs conspicuously as long, perthitic and nonperthitic tabular megacrysts. Where perthitic, it has the structure of thread (most common), ribbon, and patch perthite. Megacrystic microcline is inclusion-free as well as sparsely poikilitic, commonly containing small inclusions of quartz o plagioclase as well as enclosing perthitic potassic feldspar Potassic feldspar also occurs in smaller grains as a groundmass Quartz is a rare-to-sparse groundmass constituent that commonly has undulose extinction. It also occurs as chadacrysts in poikilitic potassic feldspar and amphibole. Myrmekite commonly has developed within small grains of plagioclase where such grains occur marginal to potassic feldspar or as bulbous protrusions where small grains of plagioclase are completely enclosed by potassic feldspar. Locally, where in contact with potassic feldspar, some myrmekite has clear albitic One of the most abundant constituent of this suite of rocks is pleochroic, colorless to green amphibole that compositionally is mostly in the range of magnesio-hornblende to edenite and is commonly poikilitic. At many places it has cores or patches of relict pyroxene as in some of the pyroxene monzonites and may have formed deuterically from pyroxene during late-stage

crystallization of the parent magma. In one rock, amphibole

contrasts with the common irregular replacement texture and

supports a magmatic overgrowth of younger amphibole on older

encloses well-formed pyroxene with sharp contacts. This feature

grains of quartz, plagioclase, potassic feldspar, epidote, apatite and amphibole.

Pleochroic, brown- to greenish-brown biotite is an important and common accessory of these rocks. It is a groundmass constituent in well-formed as well as ragged crystals. In places it is poikilitic and encloses fine-grained titanite (sphene) and euhedral apatite. Locally it occurs within clots or clumps, and, in such habit, it is closely associated with well-formed epidote.

Epidote and clinozoisite(?) occur mostly as fine-grained granular alteration minerals within plagioclase. Less commonly epidote occurs as well-formed large subhedral grains. Magnetite is the principal fine-grained, opaque oxide and imparts a noticeable magnetic susceptibility to this suite of rocks. It ranges from euhedral to subhedral in habit. Some opaque oxide locally is rimmed by titanite and may be ilmenitic. Titanite (sphene) is a minor fine-grained constituent in diamond-shaped euhedra and as rounded grains. As stated above, in some rocks it mantles opaque oxides. Locally, titanite has undergone partial

noticeable magnetic susceptibility to this suite of rocks. ranges from euhedral to subhedral in habit. Some opaque oxide locally is rimmed by titanite and may be ilmenitic. Titanite (sphene) is a minor fine-grained constituent in diamond-shape euhedra and as rounded grains. As stated above, in some rocks in mantles opaque oxides. Locally, titanite has undergone partial alteration to leucoxene. Titanite occurs as inclusions in many poikilitic minerals. Apatite is a sparse but ubiquitous finegrained prismatic mineral and generally occurs as a chadacrys within poikilitic minerals. Chlorite is minor and mostly occurs as a pseudomorph of biotite, and less commonly of amphibole. Allanite is a rare, fine-grained metamictic constituent MAFIC AND ULTRAMAFIC ROCKS (ORDOVICIAN) -- A very poorly exposed mafic and ultramafic mass. It apparently is composite, as suggested by the few available bedrock exposures. It contains partiall serpentinized pyroxenite consisting of well-formed diopside that is rimmed by antigorite. Amphibolitic, diopside metapyroxenite is also present as a medium-grained rock with cores of diopside enclosed by tremolite that apparently has replaced it marginally. Thin, barely megascopic gash veinlets of chlorite locally are present in parts of the mafic mass. The mafic mass of

pyroxene. Inclusions of the poikilitic amphibole include small

the Lahore Complex is inferred to be intruded by the granitoids of the Lahore Complex on its south side although this intrusive relationship cannot be demonstrated unequivocally because of poor exposure. Although originally interpreted as an olistolith it could conceivably be an early metamafic intrusion that accompanies the Lahore

OCCOQUAN PLUTON (ORDOVICIAN)—Fine— to medium—grained leucocratic lineate metamonzogranite. Twinned and untwinned plagioclase somewhat more abundant than microcline. Quartz ocurs as polycrystalline mosaic—textured clots or aggregates that in large measure define the lineation. Fine—grained muscovite is a common accessory; white mica occurs as an alteration on plagioclase. Granular epidote is also common and mostly occurs as alteration on plagioclase. Well—formed, fine—grained, green chlorite is also a common groundmass accessory. Biotite is locally present and is partly altered to chlorite.

Ogs GREEN SPRINGS PLUTON (ORDOVICIAN)—Composed of coarse—to medium—grained, melanocratic metamafic rocks along part of east margin of pluton. Includes a variety of rocks such as metadiorite, amphibolite, metagabbro, metamafic augen gneiss and hornblendite.

Dioritic rocks contain plagioclase clouded with white mica as well as white mica that is interstitial. Margin of pluton cut by abundant granitoid dikes

O61j LAKE JACKSON PLUTON (ORDOVICIAN OR CAMBRIAN OR BOTH)—Fine—to medium—grained, mesocratic, strongly foliated and locally lineate micaceous metatonalite. Plagioclase (albitic) is moderately to heavily altered by fine—grained white mica and granular enidate. Quartz an equally

LAKE JACKSON PLUTON (ORDOVICIAN OR CAMBRIAN OR BOTH)—Fine— to medium-grained, mesocratic, strongly foliated and locally lineate micaceous metatonalite. Plagioclase (albitic) is moderately to heavily altered by fine—grained white mica and granular epidote. Quartz, an equally abundant groundmass constituent, commonly has been recrystallized into granoblastic to mosaic—textured aggregates. In strongly lineated rocks such quartz forms flattened blebs that along with dimensionally aligned feldspar impart a mineral lineation. Biotite, commonly enclosing grains of epidote, defines a discontinuous, sinuous foliation in some of the metatonalite. Green chlorite (pseudomorphous after biotite(?)) also closely associated with epidote, occurs in discontinuous folia. Muscovite is a constituent aligned within folia in some rocks. Perthitic feldspar is generally a very minor constituent. Allanite is also a minor constituent and is locally rimmed by epidote. In places, metatonalite contains septa

is locally rimmed by epidote. In places, metatonalite contains septa f phyllite which it has intruded GOLDVEIN PLUTON (ORDOVICIAN OR CAMBRIAN OR BOTH) -- Coarse- to mediumgrained, mesocratic, weakly to strongly foliated metamonzogranite. Altered feldspars impart pink and green colors to parts of the pluton. Potassic feldspar is perthite and clouded by finely divide microscopically irresolvable matter that has a  $\ensuremath{\mathbf{w}}$ hitish color under reflected light. Perthite is commonly fractured and annealed by quartz veinlets that are restricted within the perthite megacrysts Perthite commonly encloses fine-grained plagiocf 1ase but plagioclase also occurs as a groundmass as well as megacrystic mineral. It is weakly to heavily altered by fine-grained white mica. Quartz is abundant commonly as a granoblastic groundmass aggregate with internal dimensional alinement; all quartz has undulatory extinction. Muscovite, a fine-grained minor constituent, in places is aligned within foliated groundmass quartz; coarser grains are commonly bent. Garnet is a rare constituent in some of the  $\,$ metamonzogranites and reflects the peraluminous character of these

TRONDHJEMITE (CAMBRIAN) -- Allotriomorphic granular, fine-grained,

locally having granophyric texture consisting of intergrown albite  $% \left( \mathbf{r}\right) =\left( \mathbf{r}\right)$ quartz. Muscovite and biotite may also chlorite are common, and chlorite appears to be pseudomorphic after other micas. Blue-green amphibole is locally abundant, and garnet is present at many places PLAGIOGRANITIC TONALITE (CAMBRIAN) -- Plagiogranites and related rocks; normally leucocratic to mesocratic quartz-rich meta-intrusive rocks. Typically plagioclase-rich, having minor or no potassic feldspar. Chemically, these rocks have a low potassium content. The degree of alteration is variable in the plutons that are composed of plagiogranitic rocks. In places, plagioclase is slightly altered to epidote, white mica, and chlorite. Elsewhere, feldspar is highly o completely altered to the above minerals. Quartz, which is generally blue in color, forms granoblastic-textured aggregates that locally have a core of coarse-grained quartz having wavy extinction. Garne is locally present. Hornblende varies from a minor to an abundant constituent, particularly in the southwest belt of the pluton. Many of the plagiogranitic rocks have undergone cataclasis to varying grees and locally are protomylonitic to mylonitic AMPHIBOLE METAGABBRO (CAMBRIAN) -- Coarse- to medium-grained melanocratic, massive as well as foliated rock where it intrudes the

Chopawamsic Formation. There it is composed predominantly of

pleochroic green-to-blue green amphibole and twinned and untwinned

plagioclase that in places is heavily clouded by granular epidoteinozoisite. Plagioclase generally is in the range albiteoligoclase but originally was probably more calcic prior to greenschist metamorphism and being saussuritically altered (epidote inclusions). Minor quartz is also present and euhedral magnetite is an important accessory in some rocks; pyrite is also locally present. Some felsic groundmass material is very fine-grained and has granoblastic texture suggesting cataclasis and recrystallization. Where amphibolitic metagabbro intrudes the Ta River Metamorphic Suite (amphibolite-grade) it consists of coarse-grained amphibole and altered plagioclase in a groundmass of fine-grained plagioclase and some quartz. Epidote is generally abundant 62gm GARRISONVILLE MAFIC COMPLEX (CAMBRIAN AND(OR) PROTEROZOIC) -- fine - to coarse-grained, melanocratic, massive- to foliated metamafic rocks Metamafic rocks are chiefly amphibolite and hornblendite with lesser amounts of metapyroxenite (enstatite,-bearing), metawebsterite, and metanorite in the western part of the complex. Metamorphic alteration is less intensive in the western part of the complex. Also, at the west edge of this complex, talc-amphibole schist occurs near the contact with the country rock. Amphibolite normally consists of common hornblende that may or may not have blue-green "uralitic" hornblende. In places, large hornblende grains are poikilitic. Actinolitic and cummingtonitic amphibole are present locally. Plagioclase ranging in composition from oligoclase to calcic andesine (flat-stage measurements) is generally slightly to

present in variable amounts in some of the amphibolites; magnetite and ilmenite are common accessory minerals. Hornblendite consists essentially of coarse-grained common hornblende in a groundmass of finer grained common hornblende and sparse amounts of quartz or  $% \left\{ 1\right\} =\left\{ 1\right\} =\left\{$ GZum UNDIVIDED MAFIC ROCKS (CAMBRIAN AND(OR) PROTEROZOIC) -- Metapyroxenite, hornblendite, and schist. Metapyroxenite is commonly a coarsegrained diopsidic rock with partial to extensive alteration of diopside to amphibole. Anhedral to euhedral magnetite locally is abundant as a groundmass accessory and as inclusions within diopside and amphibole. Hornblendite consists of coarse-grained common nornblende and as fine-grained, foliated amphibolitic rocks. These fine-grained rocks in places consist of an amphibolitic groundr with small porphyroblasts(?) of euhedral amphibole locally altered to chlorite and glomeroporphyritic plagioclase. Granular to subhedral titanite (sphene) and granular epidote-zoisite are groundmass constituents as well as inclusions in amphibole. Schist is generally

neavily altered by clinozoisite or epidote. Quartz and chlorite are

grained metacrysts

PzZd DIORITE GNEISS (LOWER PALEOZOIC AND(OR) PROTEROZOIC)—Gray fine—to medium—grained well—foliated and highly lineate, quartz—plagioclase—biotite gneiss containing abundant well—formed accessory epidote and locally, sparse garnet and minor amounts of mus covite. Also locally grades into granodiorite. Plagioclase is clear or clouded by submicroscopic irresolvable matter or fine—grained crystalline epidote. Dikes of foliated metamonzogranite commonly intrude the gneiss. Such dikes contain muscovite and in places also finer grained biotite. Garnet in accessory in some of these metamonzogranite dikes

PzZng GRANTIC GNEISS (LOWER PALEOZOIC AND(OR) PROTEROZOIC)—Fine—to medium

composed of garnet enclosed in a fine-to-medium grained matrix of

quartz and alined brown biotite some of which occurs as coarser

GRANITIC GNEISS (LOWER PALEOZOIC AND(OR) PROTEROZOIC) -- Fine - to mediumgrained, anhedral-elongate, streaky granitic gneiss. Ranges modally from granite to tonalite. Intimately interlayered with and contains inclusions of biotite gneiss, biotite schist, and amphibolite of the Po River Metamorphic Suite. Occurs as irregular tabular or lenticular masses. Composed primarily of greenish-brown biotite, oligoclase, and quartz. Microcline is present locally, generally as porphyroblastic grains or, with quartz and mica, in concordant pegmatitic layers. Muscovite, epidote, titanite, and magnetite are minor constituents. Subhedral green hornblende locally occurs within diffuse compositional layering, particularly in proximity to amphibolitic xenoliths or layers and may be xenocrystic. Most mineral grains have smoothly curved or moderately irregular grain boundaries. Quartz grains generally show strain shadows, diffuse grain boundaries, and local subgrain formation Because of poor exposure, size and shape of exotic blocks within melange formations are mostly inferred. Also, only one type exotic block is shown

under Correlation of Map Units. The total range of exotic blocks is listed

GEOLOGY OF PART OF THE NORTHERN VIRGINIA PIEDMONT

LOUIS PAVLI

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SCALE 1:100 000

1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

1 CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND CONTOUR INTERVAL 10 METERS